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U. S. GEOGRAPHICAL AND GEOLOGICAL SURVEY OF THE ROCKY MOUNTAIN REGION
F. V. HAYDEN, IN CHARGE

ON PREHISTORIC TREPHINING AND CRANIAL AMULETS

BY

ROBERT FLETCHER, M. R. C. S., ENG.
ASST. ASST.-SURGEON U. S. ARMY.

(CONTRIBUTIONS TO NORTH AMERICAN ETHNOLOGY, VOL. V.)

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[FROM CONTRIBUTIONS TO NORTH AMERICAN ETHNOLOGY VOL. V]

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ENTER to continue _:

information
results

LIST OF ILLUSTRATIONS.

		Page.
PLATE	I.—Cranial amulets	5
	II.—Cranium exhibiting surgical trephining	7
	III.—Crania showing effect of fracture and disease	8
	IV.—Vertex of skull showing effect of saber-stroke	10
	V.—Cranium exhibiting effect of early surgical trephining	11
	VI.—Cranium exhibiting both surgical and post-mortem trephining	13
	VII.—The Inca skull from Peru	24
	VIII.—Instruments for trephining used by the Kabyles	26
	IX.—Cranium artificially trephined by M. Championnière	29
FIGURE	1.—Perforated skull from Sable River, Michigan	24
	2.—Fragment from Kabyle skull	26

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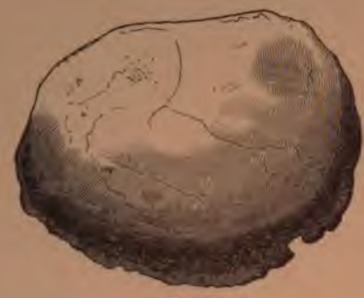


FIG. 1.

FIG. 2.

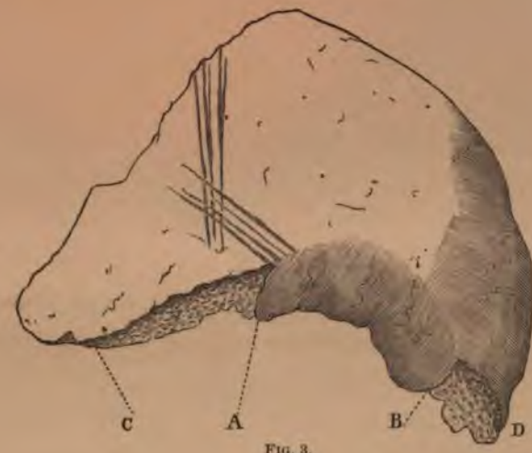


FIG. 3.

FIG. 4.

FIG. 5.

FIGS. 1 and 2. The rondelle of Lyons. FIG. 3. An amulet from La Lozère: A–B, the cicatrized edge from surgical trephining; A–C, B–D, post-mortem sections. FIG. 4. A–B, cicatrized edge. FIG. 5. Amulet with groove for suspension. All natural size. (Broca.)

ON PREHISTORIC TREPHINING AND CRANIAL AMULETS.

BY ROBERT FLETCHER.

Since the publication of Professor Broca's interesting article on Cranial Amulets and Prehistoric Trephining, in 1877,[1] no connected account has been attempted, so far as the writer knows, of the additional discoveries which have been reported. These are scattered through the journals on anthropology, and it would seem that a review of the whole subject, commencing with a summary of Broca's observations and arguments, and bringing together subsequent discoveries, would not only be of interest in itself, but might result in more careful observation, leading perhaps to discoveries of a similar custom in America.

The first communication upon the subject of cranial amulets, and which led to the discovery of evidence of prehistoric trephining, was made in August, 1873, by M. Prunières, at the meeting, at Lyons, of the French Association for the Advancement of Science.[2] M. Prunières is well known for his researches in connection with the dolmens of La Lozère. He exhibited to the association a piece of bone of an ovoid shape, 50 millimeters by 38 in its two diameters. (See Plate I, figs. 1 and 2.) The two faces were untouched, but the edges had been beveled and most carefully polished. It was discovered in the interior of a skull the entire side of which had been cut away, but it was not a part of this skull; the difference

[1] Sur la trépanation du crâne, et les amulettes crâniennes à l'époque néolithique, par Paul Broca. Paris, 1877, 8°. *Also*, Rev. d'anthrop., Paris, 1877, vi, 1-42; 193-225. *Also*, Congrès d'anthrop. et d'archéol. préhist., Budapest, 1876, 101-192.

[2] Assoc. française pour l'avancement des sciences. Compte rendu de la 2me sess., Lyon, 1873, Paris, 1874. 8°, p. 703.

in color, thickness, and density of structure showing, beyond a doubt, that it had formed part of another cranium.

At various times similar pieces of bone were discovered, in some of which holes had been drilled or grooves cut, as if for the purpose of suspending the fragments from the person. The name of "rondelles" has generally been applied to these fragments, although some archæologists, accepting the theory of M. Prunières, have termed them *amulets*. (Plate I, figs. 3, 4, and 5.)

The use of amulets, as is well known, comes down from the very earliest period, and M. Prunières was of opinion that the extreme care bestowed in polishing these fragments, together with the fact that no other purpose could be divined for them, was sufficient evidence as to the use for which they were intended. The latter reason, it must be admitted, is not strikingly convincing.

As early as 1868, M. Prunières discovered, in a large dolmen near Aiguières, a skull of which a large part of the side had been removed. This operation had evidently been effected by a cutting or sawing process, although one portion of the edge appeared smooth and polished. Many "rondelles" were discovered in the same spot, and M. Prunières formed the theory that they were pieces removed in converting a skull into a drinking cup. To drink from the skull of a dead enemy was a refined enjoyment not exclusively practiced in the Walhalla of the Norsemen. Livy tells us that the Gauls celebrated their victories in that manner,[3] and M. Prunières supposed that the skull and fragments which he had unearthed were relics of a similar custom. He made known his views to the Paris Society of Anthropology in 1874,[4] accompanying his communication with specimens of perforated skulls and rondelles.

These pieces were examined by Professor Broca, who at once observed that the smooth or polished condition of parts of the edges of the rondelles

[3] A cup made from a human skull was exhumed by Mr. E. R. Quick, in 1880, from an aboriginal cemetery near Brookville, Franklin County, Indiana. From its size, and from the distinctness of the sutures, it was evidently the skull of a young person. The base had been removed, and both the inside and outside had been scraped, as the scratches on the bone indicated. Two small holes had been drilled at one spot near the edge, evidently for the insertion of tendons or strings to check an incipient crack, just as the modern housewife saves a bowl or teacup. Journal Cincinnati Soc. Nat. Hist., 1880–'81, iii, 296. Plate of same in vol. iv, p. 257.

[4] Bull. Soc. d'anthrop. de Paris, 1874, 2me sér., ix, 185–205.

Cranium from the cavern of L'Homme-Mort (La Lozère). Surgical trephining has been performed upon the sagittal suture. Two-thirds natural size. (Prunières.)

and of the sections of the skull was due, not to artificial polishing, but to a process of natural cicatrization, which must necessarily have taken place during life, and, indeed, many years before death. (Plate II.)

After examination of a great many other specimens, Broca finally announced two conclusions as the result of his investigations:

I. In the neolithic age, a surgical operation was sometimes performed for the cure of certain internal maladies, which consisted in making an opening in the skull. This was almost, if not quite, exclusively practiced on young children, and is to be termed *prehistoric surgical trephining.*

II. The skulls of those who survived this operation were supposed to possess some remarkable qualities, and when the owners died, amulets or rondelles, consisting of portions of the skull, were carefully cut out. By preference, the portion should contain a segment of the original aperture. This was *posthumous trephining.*[5]

A concise account must be given of the evidence upon which these conclusions were based.

To the practiced eye there is no difficulty whatever in distinguishing between a section of bone which has not been followed by any reparative process and one in which that process has gone on to completion. In the first case, the edges are sharp, the cells of the diploë are open, and the action of the cutting instrument is seen in the successive cuts by which the operation has been performed. It is not uncommon to find scratches on the surface of the bone, indicating where the tool had slipped away from the intended incision. (Plate I, fig. 3.)

When cicatrization of a trephined or fractured skull has been perfected, the edges present a rounded, ivory-like surface, due to the new osseous tissue deposited in the cells of the diploë and upon the edges of the outer and inner tables.

But while it is easy to discriminate between a post-mortem incision and one long since healed, it would be very difficult to decide that the incision might not have been made during life, but shortly before death. The process of repair in bone is much slower than in softer tissues, and it has been suggested that the cases of so-called posthumous trephining were really

[5] Sur la trépanation du crâne, etc., p. 9.

cases in which the operation had resulted fatally in a very short time, and before any process of repair had commenced. To this it may be replied that no examples have hitherto been found of skulls or rondelles where the section was *in process* of cicatrization; all are either entirely fresh, or long since healed.[6] It would be unreasonable to suppose that these operations were entirely successful or else immediately fatal. The operation, in itself, is not very dangerous to life, as has been shown by many experiments on animals. Its mortality as a surgical measure, in cases of fracture of the skull, is due to the serious injury to the brain for which it becomes necessary to employ it.

A more convincing reply is that, in the greater number of the trephined skulls in question, *the two sections coexist;* a portion exhibiting the rounded, ivory surface of ancient cicatrization, the rest of the section being absolutely fresh. (See Plates I, V, and VI.)

The suggestion that these apertures were the result of blows from weapons must be at once dismissed. No weapon of that day, or this, could produce such openings with their well-defined, beveled edges. The blows of stone hammers or axes resulted generally in necrosis, or death of the bone, and often in disruption or bulging of the inner table of the skull for some distance from the seat of injury. Some excellent examples of the consequences of such formidable injuries are to be seen in an article by Dr. F. W. Langdon, describing the crania in a prehistoric cemetery at Madisonville, Ohio.[7] The accompanying plate (Plate III), copied by Dr. Langdon's permission, well illustrates the striking difference between the results of blows followed by necrosis of the bone, and the condition succeeding the operation of trephining.

The apertures made by the so-called surgical trephining do not differ greatly in size; they are nearly always elliptical, seldom round, and extend from 35 to 50 millimeters in length, by 6 to 10 millimeters in breadth. The edges are very oblique, at the expense of the outer table of the skull. The operation appears to have been performed upon all parts of the head,

[6] Some more recent discoveries, however, which will be referred to later, show that this assertion of Broca's was rather too sweeping.

[7] The Madisonville prehistoric cemetery; anthropological notes. By F. W. Langdon, M. D. Journal of the Cincinnati Soc. Nat. Hist., iv, Oct., 1881, 250–253.

FIG. 1.

FIG. 2.

FIG. 1. Perforating fracture of the left parietal near its posterior superior angle; internal view showing the depressed fragment of the internal table which has reunited. FIG. 2. Result of injury to right frontal and parietal region, causing extensive sinuses between the inner and outer table. Natural size. (Langdon.)

excepting the forehead, but in the greater number of instances one of the parietal bones has been the chosen site. There is a very interesting skull in the Musée Broca [crâne de Vauréal (Oise)], which, in addition to a large depression in the frontal bone, presents a remarkable instance of trephining on the occipital, two-thirds of that bone having disappeared. Part of this opening is due to the surgical operation, the elliptical edges, about half of the original aperture, exhibiting the characteristic ivory-like surface of cicatrization, while the remainder has been removed by post-mortem trephining.[8]

In no instance has an artificial opening been observed excepting where the bone was covered by the hairy scalp, and that the purpose was to avoid noticeable disfigurement seems a justifiable conclusion. It is also another argument against possible origin from wounds in battle, as in such cases the forehead was the part most liable to be injured.

Broca states that the operation must have been performed just as frequently on the female as on the male.

It is necessary to inquire what other causes may account for abnormal cranial apertures.

I. There are congenital deficiencies. These are generally found in the parietal bones, and are nearly always symmetrical, being found in both bones. A single congenital aperture has been sometimes observed through which hernia of the brain and meninges has taken place. In such cases the edges are everted and show a more or less diseased condition.

II. Disease of the bone may produce openings which may afterwards become cicatrized, and thus resemble the apertures in question; but disease of the bone always extends beyond the limits of the perforation produced, and leaves indelible traces. A close examination of these trephined neolithic skulls shows a perfectly sound condition of the bone in the vicinity of the aperture in all cases.[9]

III. Traumatic sources have been already discussed and dismissed. Even the cavalry saber of to-day could not produce such results. It does

[8] Lésions osseuses de l'homme préhistorique en France et en Algérie, par Jules Le Baron. Paris, 1881, 4° (thèse), p. 47.

[9] In this Broca was mistaken. A very remarkable instance of trephining in connection with disease of the bones of the cranium was communicated to the Société d'anthropologie by M. Parrot, in 1881. A description of the relic will be found farther on.

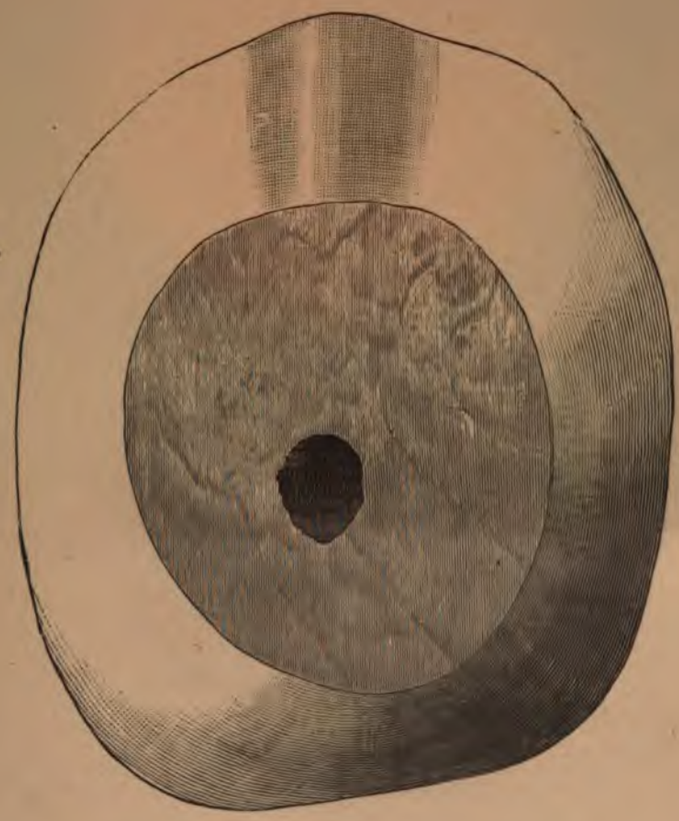
occasionally cut off a slice of the cranium, but it certainly could not cut out rondelles from the parietal bones. (See Plate IV.)

Contused wounds, such as would be produced by rude weapons, produce necrosis or death of the bone, and where healing takes place irregular apertures remain, entirely unlike the result of a surgical operation.

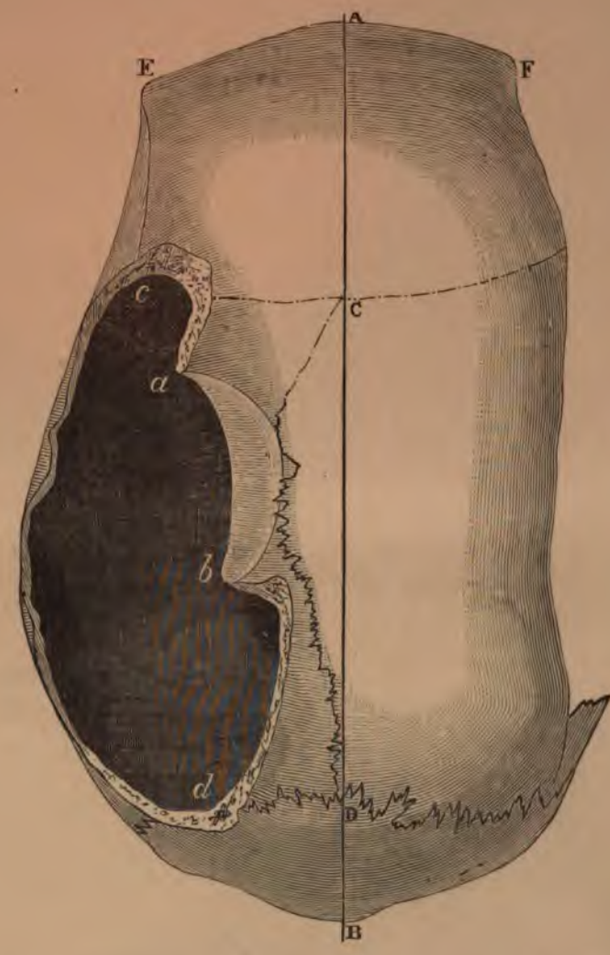
The reparative process in wounds of the cranium in the adult is one of extreme slowness. An osteitis, or inflammation of the bone, is set up, which extends to some distance from the edges of the wound. The vascular canaliculi of the two tables become dilated, and it is often years before they recover their normal caliber. But in the skulls under discussion, in all instances, the edges of the aperture made by surgical trephining exhibit the most perfect readjustment of the parts. This is the case in young as well as in old crania; in one instance particularly, that of a woman of less than twenty-five years of age, the wisdom teeth being still in process of development, the traces of the traumatic inflammation have as completely disappeared as in the skulls of very old persons. This led Broca to believe that the operation must have been performed at a very early age, and other observations tend to confirm that theory. Although the operation of trephining, as before stated, is not a very dangerous one when uncomplicated by injury to the brain, yet it would be unreasonable to suppose that it was never fatal. If sometimes fatal, we should expect to find skulls exhibiting the evidence of partial recuperative process. But, with one exception, no such relics have been discovered; the edges of the openings are either absolutely fresh, indicating post-mortem work, or absolutely cicatrized, indicating that the operation had been performed many years before the death of the subject. What then became of the failures?

If the operation was performed only on young children, then the rapid decay of their tender bones would answer the question. In dolmens containing a large number of adult crania, it is usual to find nothing but mere débris of the bones of children, and in the case of trephined skulls, the thin edges of the apertures would offer favorable points for the chemical and physical agency of erosion.

It is unnecessary to relate all the observations and arguments which led Broca to the conclusion that prehistoric trephining was performed mainly,



Loss of substance from the vertex of a skull produced by the stroke of a Tartar saber. Natural size. (Musée Broca.)



Cranium from Cibournics. A–B, median line; E, left external orbital apophysis; F, right external orbital apophysis, broken. *a–b*, the cicatrized edge of surgical trephining; *a–c*, *b–d*, post-mortem sections. The sagittal suture, instead of following the line C–D, has been driven over to the left. Two-thirds natural size. (Broca.)

if not entirely, upon the young child, but one especially striking and ingenious illustration which he founded upon a cranium discovered by Prunières in the dolmen of Cibournios must be related.

It is well known that the sutures of the skull tend to become firmly united with the advance of years. In the young child the remains of the sutural membrane still exist, and a separation is easy. In the accompanying drawing it will be perceived that the left parietal bone has been operated upon, and the resistance of the arch on that side being thereby diminished, the right parietal has encroached considerably over the median line, in the process of after growth, indicating the youth of the subject at the time of the operation. (Plate V.)

As regards the general harmlessness of the operation, there is a view which must be suggested, in passing, which has not been considered before in this connection, and that is the relation of race to traumatism. In other words, the capacity to bear wounds or surgical operations, or the contrary, dependent not on individual but on race characteristics. Long ago, Velpeau said that French flesh and English flesh were quite different, and operations that were generally successful in the one were frequently fatal in the other. The subject is of immense extent, requiring copious observations, which should include toleration of child-bearing, before any conclusions can be reached. It will be seen presently that the Arab tribes who practice trephining regard it as almost without danger. It is possible that race is to be regarded as a factor in the calculation of the results of trephining.

Some account must now be given of the probable manner of proceeding in prehistoric trephining.

There are three processes by which an opening in the cranium can be methodically produced—by rotatory movement, by cutting, and by scraping.

The most perfect example of the first-named method is in the use of the modern trephine, which consists of a steel cylinder with saw-teeth and a central pin to guide its first motion; the whole being worked by a cross-handle like that of a gimlet. This instrument cuts out a circular piece of bone, leaving a corresponding aperture with perpendicular edges. The first form of the trephine dates back to the early days of Greek surgery; cer-

tainly to more than 500 years before the Christian era. While, of course, no instrument of this kind could have been known in the neolithic age, yet an opening by terebration could have been obtained with any pointed tool. M. Prunières says that the shepherds of La Lozère practice it to this day, to relieve sheep of the "staggers." The head of the animal is held between the knees of the operator who fixes the point of his large sheath-knife in the skull, and by rotation of the handle between his hands a hole is speedily produced. A similar practice prevails in Germany, according to Veckenstedt, the operation being performed by the shepherds in order to "burst a bladder in the inside of the head of the sheep." But all such openings are necessarily round, with nearly perpendicular edges, while the surgical trephining of prehistoric times is characterized by elliptical openings and by obliquely beveled edges.

As regards the second method, by cutting, no doubt flint saws might have been employed for the purpose, but it would have been impossible to produce the even ellipsis, with its broad bevel, in such a manner. A polygonal-shaped aperture could only have resulted.

There remains the process by scraping. In some of the South Sea Islands trephining is practiced in this manner, and, indeed, the exfoliative trepan of modern surgery provides for a similar process. Broca presented to the Society of Anthropology of Paris, in 1876, some skulls upon which he had himself produced precise counterparts of neolithic trephining by scraping with a piece of broken glass.[10] The apertures were elliptical, the long axis being in the direction of the to-and-fro motion of the scraper, and the edges were broadly beveled. It might seem, at first, that this must have been a very slow and barbarous operation, but when it is remembered that the evidence points strongly to the belief that trephining was practiced upon the very young, the objection, to a great extent, disappears. It took Broca nearly an hour to produce the opening in a hard adult cranium, but in a child's skull it required but four minutes to attain the same result. Again, in July, 1877, Broca presented to the same society the skull of a two months' old puppy, upon which he had performed the operation of trephining with a piece of flint from Cro Magnon, and, although the flint was

[10] Bull. Soc. d'anthrop. de Paris, 1876, 2me sér., xi, 512.

Cranium from Cibournios. A–B cicatrized edge from surgical trephining. B–C, A–D, post-mortem sections. Two-thirds natural size. (Broca.)

very blunt and the bone twice as thick as that of a child of six years of age, the operation was completed in eight minutes; the dog recovered rapidly without any symptom of fever.[11]

It is a curious fact that the amulets or rondelles, in the great majority of instances, have been cut from skulls which had undergone, and a long time survived, surgical trephining. Many of these skulls exhibit immense openings, unmistakably of post-mortem workmanship, but with a fragment of the original cicatrized edge of the surgical operation remaining. (See Plates V and VI.)

Many crania have been discovered with the characteristic opening indicating surgical trephining long since cicatrized, but which had been subjected to no post-mortem operation. Why these exceptions should occur it is impossible to discover. Possibly they were due to the law of demand and supply, and the amulets not being wanted at the time, the skulls were left undefaced.

Quite a large number of these so-called amulets or rondelles have been discovered, and are to be seen in the museums of Europe.[12] Some of them are very regular in outline, and very considerable labor has been bestowed upon them to produce a polished surface and rounded edges. The rondelle discovered by Professor Prunières in the interior of a skull, and which first drew attention to the subject, is highly polished and beveled at the expense of the outer table. (Plate I, fig. 1.) These carefully prepared amulets have a very different appearance from the fragments of cranial bone which are found in ancient burial places. The latter are more or less discolored and eroded by the moisture and mineral ingredients of the soil in which they have rested. The rondelles, on the other hand, have a dry, hard surface, and are almost of the color of old ivory. This is probably due to their having been worn as ornaments or amulets for a very long time; perhaps by many successive owners. Other amulets are of irregular shape, being elliptical, trapezoid, or triangular. Some amulets have been found with a

[11] Bull. Soc. d'anthrop. de Paris, 1877, 2me sér., xii, 400; 477.

[12] Prunières. Sur les crânes perforés et les rondelles crâniennes de l'époque néolithique. Assoc. française pour l'avancement des sciences. Compte rendu, 3me sess., Lille (1874), Paris, 1875, 597–637. ——. La crémation dans les dolmens de La Lozère. Nouvelles rondelles crâniennes. Dolmens de la Marconière et tombelle de Boujoussac. *Ibid.*, 6me sess., Le Havre (1877), Paris, 1878, 675.

groove cut around them, apparently for the purpose of suspending them from the neck. (Plate I, Fig. 5.)

It now remains to give some account of Broca's theory as to the purpose of this surgical and post-mortem trephining. He rejected the theory that the surgical operation in early life was performed on account of fracture or disease of the bone, nothing whatever in the relics seeming to indicate such conditions. He was, at one time, disposed to think that the operation had a religious or superstitious motive, and that it indicated initiation into some sacred order; but the extent of the discoveries of trephined skulls, and the fact that women as well as men were subjected to the operation, obliged him to give up that view. His conclusion was that, in all probability, the operation was performed as a cure for convulsions, simple or epileptic.

Trephining as a curative treatment for epilepsy has been practiced somewhat extensively in our own day, but it is now entirely abandoned, except in cases of traumatic epilepsy, when the manifestation of the disorder has been coincident with an injury to the skull. In such cases, removal of depressed fragments of bone is clearly indicated, and has, in many instances, been followed by entire disappearance of the epileptic fits.

In the curious storehouse of absurdities which our ancient Materia Medica exhibits, powdered bone from the human skull, as well as powdered mummy, figure as unfailing remedies for epilepsy. Sometimes the bone was to be calcined, and the supplementary ossicles of the skull, known as *ossa Wormiana*, were in high repute for this purpose. In old works the title of *os antiepilecticum* was an ordinary name for a Wormian bone.

For many ages epileptics were believed to be possessed of devils and to be fit subjects for exorcism. When, in obedience to spell or potent command, the evil spirit left the sufferer, or, in other words, when the fit was over, it was through the open mouth that the exit was made. There is a cut in a curious old German block-book representing the well-known incident of the epileptic of the New Testament. The mouth of the man is painfully distended, and the horned head of a small imp is visible emerging from his throat. The herd of swine, unconscious of the impending catastrophe, are watching the proceeding. It is not difficult to imagine how appropriate it would appear to make an opening in the skull for the escape

of an evil spirit which could not be dislodged by ordinary exorcism.[13] It is for this purpose, among others, that trephining is practiced to this day among the South Sea Islanders and by some of the Arab tribes of Algeria.

From these and similar considerations Broca was led to believe that prehistoric trephining was practiced for the relief of convulsions in infancy or childhood, and that a fragment of the skull of a person who had undergone this operation was worn as a preventive of the like common and alarming disorder. Hence the care with which a portion, at least, of the cicatrized border was preserved in the piece cut out to form the amulet.

It must be borne in mind that a primitive people would not be likely to discern any difference, except of degree, between the ordinary convulsions of childhood and epileptic fits. The former, though alarming in appearance, are by no means generally dangerous, and we can easily understand that the surgical operation would, in such cases, be credited with the cure. It is thought, even in our own enlightened day, that the *post quod* is occasionally taken for the *propter quod*, in surgical as well as medical therapeutics.

So far, it may be said that Broca made a fair case in favor of his theory, but he carried his theorizing still further. He was of opinion that these trephined skulls and corresponding amulets indicated that a belief in a future existence obtained among these primitive races. His argument is based upon the discovery of amulets in the interior of trephined crania. "Why," he asks, "was this precious relic placed inside the skull at burial? Was it not a talisman to preserve the defunct, in a future existence, against the evil spirits that had afflicted him in early life? If so, does it not show that a future existence was anticipated?"

When it is remembered that only three cases have been observed in

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[13] A curious custom is related by Miss A. W. Buckland, which may possibly be due to some legendary trace of the belief in the efficacy of trephining as a remedy for fits. She observed at Cannes, in the south of France, a number of dogs with oblong patches of red leather stuck on their heads, and upon inquiry was informed that these dogs were *subject to fits*, and that the red leather was worn as a means of prevention. Jour. Anthrop. Inst. London, 1881, xi, 16.

This part of the subject must not be dismissed without an allusion to the story of the birth of Athene, so inimitably told by Lucian. It will be remembered that Zeus, suffering from intolerable pain in the head, called upon Hephæstus to split open his head with an axe. The latter unwillingly obeyed, when from the fractured opening sprang out the Goddess of Wisdom, clad in bright armor and with spear in hand. This is probably the first recorded instance of historic trephining.

which rondelles were discovered in the interior of skulls, it must be admitted that this amiable theory rests upon a very slender foundation. It seems much more probable that their presence in the locality in which they were found was due to accidental causes, such as the pressure of roots, or the movements of worms. Mortillet and Prunières both mention finding small bones of the hand or foot inside of crania.

As regards the extent and range of the relics indicating this singular custom, it may be said that, in France, the department of La Lozère has produced the greatest number. This, however, is probably due to the vigorous researches of Prunières and others in that region. Throughout the south and southeast of France discoveries of trephined skulls continue to be made. Broca states that the custom certainly prevailed throughout the entire neolithic or polished stone period, as trephined skulls have been found in the cavern of L'Homme-Mort, in La Lozère, which belongs to the earliest part of that age, and in the grottoes of Baye, belonging to its close. While it is not surprising that no trace of the custom should have been discovered in the relics of the palæolithic or mesolithic ages, it is certainly remarkable that it should have disappeared with the neolithic age so completely. It is perhaps not too much to say that no authentic instance of the discovery of a trephined skull from the bronze period is on record. Doubtless the rapidly increasing custom of incineration of bodies must be regarded as a principal cause. M. de Baye has found cranial amulets in tombs of a later epoch, and infers that the custom of trephining still prevailed.[14] This does not, however, follow, as the amulets may have been preserved through many generations.

At the meeting of the International Congress of Prehistoric Anthropology held at Brussels, in 1872, Dr. G. A. Lagneau read a paper entitled, "Sur les crânes de Furfooz"; and in the discussion which followed the measurements of some Esthonian crania were given by M. Quatrefages. In the plate[15] illustrating the latter, one skull has an aperture about the center of the coronal suture which strikingly resembles the beveled edges pro-

[14] Bull. Soc. d'anthrop. de Paris, 1876, 2me sér., xi, 121.

[15] Congrès international d'anthropologie et d'archéologie préhistoriques. Compte rendu, 6me session, tenue à Bruxelles en 1872, Bruxelles, 1873, 558.

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duced by trephining. No allusion was made to it, the subject at that time not having been brought to light.

As early as 1875 a trephined skull was found in a tumulus at Bougon, near Niort, in the south of France, which was described by M. Babert de Juillé. In his specimen, the openings had been made near the top of the skull, and the edges were perfectly cicatrized.[16]

At the meeting of the Association for the Advancement of Science held at Nantes, M. Chauvet presented a cranial amulet found in a tumulus in the forest of Boixe.[17]

In the tertre Guérin, on the right bank of the Seine, not far from Paris, M. Chouquet found the skull of an old man, with a trephined aperture which had been long completely cicatrized.[18] M. Chouquet also discovered some specimens of both surgical and posthumous trephining in a mound, near Écuelles, which contained incinerated bones. He was disposed to think that these relics belonged to the bronze age.[19]

In 1877 M. Prunières presented to the Paris society two admirable specimens, in one of which the aperture, thoroughly cicatrized, was in the occipital bone, a little to the right of the median line—an unusual position.[20]

M. Gassies discovered a trephined skull at Entre Roche, near Bordeaux, in a burial place which he thought to be palæolithic. Further researches, however, by M. Chauvet, assigned it to the neolithic period, a polished stone axe and similar relics having been discovered there.[21] Some other doubtful cases of trephined skulls from the palæolithic period have been announced, but no well-authenticated specimens have been discovered which are of earlier date than the polished stone age.

An interesting specimen was presented to the Paris society, in 1878, by M. Guégan.[22] It was found in a dolmen at Étang-la-Ville, and exhibited

[16] Rapport de la commission des tumuli de Bougon, suivi d'une étude sur la trépanation préhistorique, et en particulier sur le crâne trépané que possède la musée de Niort. Par Babert de Juillé. Niort, 1875. 8°.

[17] Assoc. française pour l'avancement des sciences. Compte rendu de la 4me sess., Nantes, 1875, Paris, 1876, 854.

[18] Bull. Soc. d'anthrop. de Paris, 1877, 2me sér., xii, 13–16.

[19] *Ibid.*, 1876, 2me sér., xi, 279.

[20] *Ibid.*, 551.

[21] *Ibid.*, 1877, 2me sér., xii, 12.

[22] *Ibid.*, 1878, 3me sér., i, 198.

incomplete trephining by *raclage*, or scraping. This modification of the process of trephining consisted in removing the outer table of the skull by scraping, leaving the inner or vitreous table intact. Altogether some twenty specimens of the kind have been collected. What the object was of this incomplete operation it is difficult to divine. Possibly the malady was relieved and the further process rendered unnecessary.

In 1603 there was published in Lyons a book which is now excessively rare. Its title was: Traicté de l'épilepsie, maladie vulgairement appelée au pays de Provence, la goutette aux petits enfants. Par Jehan Taxil. 8°. The writer evidently confounded convulsions with epilepsy, the latter disease not attacking little children, rarely, indeed, developing itself before the tenth year. The remedy he prescribes is scraping away a portion of the outer table of the skull. Sometimes the inner table, also, was removed by the exfoliative trepan. This reproduction of a prehistoric usage may perhaps be cited as a curious instance of atavism in surgery.

In 1878 M. Prunières made some extensive researches in the caverns of Beaumes-Chaudes (La Lozère), and found more than sixty specimens of trephined skulls and cranial amulets. In three of these there was evidence of the operation having been twice performed on the same subject.[23]

In 1880 M. Mauvoisin found in some artificial grottoes near Baye several crania of the neolithic age, of which two exhibited cicatrized openings. Upon one of them post-mortem sections had been made in the usual manner.[24]

A recent and very interesting contribution to our knowledge of the subject is to be found in a paper read before the Paris Society of Anthropology by M. Parrot.[25] It describes a cranium found in a grotto of the neolithic period at Bray-sur-Seine (Marne). The frontal and both parietal bones exhibit the consequences of extensive disease. Depressions exist, such as would be produced, M. Parrot says, by pressing the thumb into soft putty. On the left parietal a small island of undiseased bone stands up in the center of the depressed portion, forming a strong contrast. The bone

[23] Bull. Soc. d'anthrop. de Paris, 1878, 3me sér., i, 211.

[24] *Ibid.*, 1880, 3me sér., iii, 10.

[25] Crâne trouvé dans une grotte de l'époque de la pierre polie à Bray-sur-Seine (Marne), avec une quarantaine de squelettes, haches polies, poinçons en os, colliers et ornements en coquilles. *Ibid.*, 1881, 3me sér., iv, 104-108.

which has been subjected to disease is excessively thin, and was broken in two or three places in the process of extraction. No trace was left of the coronal suture, the disease having entirely obliterated it. But the most interesting feature was the evidence that surgical trephining had been performed, apparently for the relief of the disease. The opening made involved the frontal and left parietal bones; it was of the usual oval shape, but its size could not be exactly ascertained, as the posterior portion of it was lost in a large, irregular hole, produced, no doubt, when the skull was removed from the earth. The trephining was performed partly on sound and partly on the diseased bone, and the edges of the aperture (what remains of them) are perfectly cicatrized, so that it is evident that the patient long survived the operation. It cannot be held that the disease was the result of the operation. In the large number of trephined skulls which have been examined there is no instance of disease of the bone, and in this particular case, as M. Parrot observes, if the disease had resulted from the operation it would have spread all around the opening, which is not the case, as what remains of the aperture is in sound bone.

The disease, which was probably an exfoliative osteitis or inflammation of the bone, was, M. Parrot thinks, of traumatic origin. There is a depression on the frontal bone which may have been caused by a hatchet-stroke. Whether the operation was performed to arrest the disease, or to remove some of its symptoms, is, of course, a matter of conjecture; but as the diseased bone and the edges of the aperture had all become firmly cicatrized, it is certain that the patient lived for some years after.

M. Parrot dwells upon the importance of this discovery as proving that trephining was employed as a therapeutic measure in disease, and not only for the relief of imaginary causes of evil, as in convulsions or epilepsy. It is possible, however, that the subjective symptoms attending such extensive disease of the cranium may have required the usual remedy for eviction of the supposed malignant spirit.

In Germany a few examples have been met with of prehistoric trephining. Prof. H. Wankel discovered in the grotto of Bytchiskala, in Bohemia, the skeleton of a girl of about twelve years of age. The skull bore unmistakable evidence of surgical trephining having been performed during life.

The aperture was on the right side of the frontal bone, was nearly circular in shape, and about 3 centimeters in diameter. The inner table of the skull exhibited no trace whatever of inflammatory process, such as would inevitably have accompanied caries or exostosis of the bone. At great length Professor Wankel examines every possible disease or injury of the bone which might be supposed to account for the opening, and rejects them all. From this argument by exclusion he arrives at a very firm belief that the case was one of surgical trephining, precisely analogous to those observed in the crania of La Lozère.[26]

About the same time Dr. B. Dudik sent a communication to the Berlin Ethnological Society, announcing his discovery of many trephined skulls in the ossuarium, or Beinhaus, at Sedlec in Bohemia.[27] In this famous bone-heap there are pyramids of skulls and thousands of human bones. Tradition states that they came from the old churchyard of Sedlec, the soil of which, having been made sacred by admixture with earth brought from Gethsemane, had the property of rapidly decaying the flesh and of preserving the bones with a whiteness as of alabaster. The structure which now incloses the relics was erected in 1709, but allusions to the Sedlec bones are to be found in very early chronicles. A local legend relates that the perforated skulls (of which there are a great many) once belonged to the Cistercian and Carthusian monks who were killed when the Hussites, under Ziska, captured the convent of Sedlec in 1421. Dr. Dudik thinks that the punctures are too even and too free from fracture to have been made by the spiked clubs with which Ziska's followers were armed. This objection is probably not well-founded. The writer remembers examining a heap of skulls of horses in a knacker's yard, the animals having been destroyed with a pole-axe, a weapon very similar to a spiked club, and the punctures were, in almost all instances, round with sharp edges and not accompanied by fracture. It seems probable that these bones have accumulated through a very long period of time, but that they date principally from the year 1318, when a pestilence ravaged Bohemia and thirty thousand persons were buried in Sedlec alone.

[26] Wankel (H.). Ein prähistorischer Schädel mit einer halbgeheilten Wunde auf der Stirne höchstwahrscheinlich durch Trepanation entstanden. Mitth. d. anthrop. Gesellsch. in Wien, 1878, vii, 86-95.

[27] Dudik (B.). Ueber trepanirte Cranien im Beinhause zu Sedlec. Ztschr. f. Ethn., Berl., 1878, x, 227-235.

Dr. Dudik describes at some length the appearance of the openings in the crania which he examined, but it would seem from his description that, in most instances, posthumous trephining alone had been practiced. This, of course, proves nothing. In a few cases he describes what seems like cicatrization of the edges.

A more competent observer, however, followed in his footsteps. Professor Wankel visited Sedlec in order to verify the observations of Dr. Dudik, and examined the one hundred and twenty crania which had been submitted to the latter.[28] Wankel was of opinion that, in every instance, the perforations were the result of wounds not immediately fatal. In two instances he agreed with Dr. Dudik that there were unmistakable marks of posthumous trephining. Professor Wankel finishes his article by a description of his visit to Prague, in the museum of which city he found two skulls from Bilin, in Bohemia, exhibiting evidence of prehistoric trephining. One, a dolicocephalic skull, presented an orifice 60 millimeters by 40, of elliptic shape, and situated in the center of the right parietal bone. The edges were perfectly cicatrized, and exhibited the ivory-like surface characteristic of long-healed trephining. In the other, a mesocephalic skull, the aperture was round and about 40 millimeters in diameter. Professor Wankel was of opinion that these skulls exhibited perfect specimens of prehistoric surgical trephining, and goes on to observe that, even to the eye of a layman, the difference between the holes in these skulls and those in the crania of the Sedlec ossuarium was most marked.

A notice of these two interesting specimens was sent to the Paris society by M. Ingoald Cludset two years before.[29]

Professor Virchow has contributed some observations illustrative of the subject. At a meeting of the Berlin Anthropological Society, in 1879, he described a skull from a neolithic burial mound, in which the characteristic marks of cicatrization were observed in an opening in the right parietal bone. At a later meeting he also reported some discoveries made by General von Erckert in a Cujavian grave near Ziemcin, in Poland. Among them was a bone disk, or rondelle, bearing a great resemblance to

[28] Wankel (H.). Ueber die angeblich trepanirten Cranien des Beinhauses zu Sedlec in Böhmen. Mitth. d. anthrop. Gesellsch. in Wien, 1879, viii, 352–360.

[29] Bull. Soc. d'anthrop. de Paris, 1877, 2me sér., xii, 10.

those described by Broca.[30] Dr. L. Schneider presented to the same society a similar example from the skulls of Strupcic, Bohemia.[31]

In 1875 an article was published by Dr. R. Wiedersheim, entitled, "Ueber den Mädelhofener Schädelfund in Unterfranken." This appeared before attention had been drawn to the subject of prehistoric trephining, but in one of the plates is a cranium with an opening in the left parietal bone, presenting a remarkably strong resemblance to the accepted form of surgical operation.[32]

At a meeting of the Italian Society of Anthropology, held in 1878, Professor Mantegazza exhibited a papier-maché model of a Russian skull taken from a tumulus at Bogdanoff, which presented an example of surgical trephining undoubtedly performed during life. Posteriorly was a second aperture of post-mortem origin.[33]

M. Nicolucci discovered in a tumulus in Italy a rondelle from the occipital bone, highly polished on both sides, but no trephined skulls have as yet been discovered in that country.

In Denmark a trephined skull was found in a dolmen at Borreby, and another was discovered by M. Engelhardt, in a dolmen of the stone age, at Noes, in the island of Falster.[34]

Broca received from General Faidherbe some casts of skulls from Roknia, Algeria, one of which proved to be an excellent example of surgical trephining. Since his death another specimen has been received from Roknia, which is deposited in the Musée Broca. In this skull the opening—of the usual beveled, elliptical shape, and 13 millimeters in diameter—is above the left external orbital apophysis. There is no evidence of repair on the edges, so that it would seem that the operation was fatal; but as the entire inner table of the skull has disappeared, from erosion, M. Le Baron suggests that the cicatrized edges may have met with a similar fate.[35]

So far no discoveries of trephined crania have been made in Great Britain;

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[30] Ueber trepanirte Schädel von Giebichenstein. Verhandl. der Berliner Gesellsch. für Anthrop., Berlin, 1879, 64–67. ——. Knochenscheibe aus einem Schädel, welche an ein trepanirtes Stück erinnert. *Ibid.*, 436.

[31] Ueber die Hradište von Stradonice und die Schädel von Strupcic (Böhmen). *Ibid.*, 239.

[32] Archiv für Anthrop., Braunschweig, 1875–'76, viii, 225–236. (Plate XV, figs. 1 and 2.)

[33] Archivio per l' antropologia, etc., Milano, 1878, viii, 527.

[34] de Nadaillac. Les trépanations préhistoriques. Paris, 1879. 8°, p. 7.

[35] Lésions osseuses, etc., 67.

but it may be mentioned, as illustrating the growth of interest in the subject, that in France counterfeit rondelles have recently been put upon the market.

In the splendid prehistoric gallery of the geological section of the museum at Lisbon is a cranium quite unique of its kind.[36] It presents evidence of an uncompleted operation of trephining upon the left parietal bone. The groove, made by some cutting or sawing instrument, has nearly reached the internal table, very clearly defining the rondelle, which measures 6 centimeters by 2, and from the numerous scratches on the surrounding bone it is evident that the instrument frequently slipped from the groove in the process. Why the piece was not entirely detached it is useless to surmise. M. de Mortillet was of opinion that the discovery rather tended to disprove Broca's theory that the operation was performed by scraping until a hole was produced. It must be observed, however, that there is no evidence to prove that the operation was performed during life in the case in question. It is more likely that it was an attempted post-mortem trephining; but even if it were not, its occurrence would only strengthen the views expressed elsewhere in this paper, that though prehistoric trephining was probably performed by scraping in the young subject, and that examples of this method form the great majority of specimens in our museums, yet that it is probable, from analogy, that when performed on the adult it was by sawing, cutting, or by a series of punctures.

The cranium in question was found in the grotto of Casa da Mouva at Peniche, which contains the remains of one hundred and forty persons of the neolithic period.

In America nothing has been discovered that can be said to belong to prehistoric trephining, except the famous Inca skull brought by Mr. Squier from Peru, and presented by him to the Paris Society of Anthropology. This relic, which consists of the face and frontal bone, is stated by Mr. Squier to have been taken from an Inca cemetery in the valley of Yucay, within one mile of the "Baths of the Incas."[37]

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[36] Notes sur l'archéologie préhistorique en Portugal, par Ém. Cartailhac. Bull. Soc. d'anthrop. de Paris, 1881, 3me sér., iv, 281-307.—Trépanation préhistorique, par A. de Mortillet. *Ibid.*, 1882, 3me sér., v, 143-146.

[37] Peru. Incidents of travel and exploration in the land of the Incas. By E. George Squier. New York, 1877. 8°, p. 456; Appendix, p. 577. It is also described in that singularly unique publication, vol. i, No. 1 (all ever published), of the Journal of the Anthropological Institute of New York for 1871-'72.

The drawing (Plate VII) shows how entirely the operation in this case differs from the elliptic openings of the French crania. The round white spot indicates where the periosteum had been removed by the operator; and this was done, Broca thought, about eight or ten days before death. The famous surgeon, Nélaton, who also examined the bone, suggested fifteen days.[38] As no evidence of fracture was visible, the French experts were of opinion that the operation was performed to evacuate fluid in the cavity, but Dr. J. P. Nott, of Mobile, offered the very plausible suggestion that a punctured wound, such as the known weapons of the Peruvians might inflict, might have necessitated the operation. The incisions appear to have been performed with a cutting instrument, something like an engraver's *burin*, and not with a saw.

In 1875, Mr. Henry Gilman, then of Detroit, published a description of ten to fifteen skulls obtained from mounds on Sable River, Lake Huron, and two fragments from Great Mound, River Rouge, Michigan.[39] All of these skulls presented a circular perforation at the vertex, "evidently made," he says, "by boring with a rude, probably stone, instrument, varying in size, in some instances having a diameter of one-third of an inch; in others, of one-half of an inch, and flaring at the surface" (fig. 1).

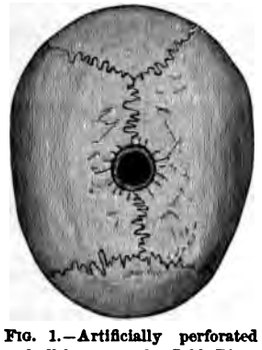

FIG. 1.—Artificially perforated skull from mound at Sable River (Lake Huron), Michigan; one-quarter size.

At the Detroit meeting of the American Association for the Advancement of Science, Mr. Gilman read a more elaborate paper on the same subject,[40] and, at the twenty-sixth meeting of the society, this was followed by another paper, entitled, "Additional facts concerning artificial perforation of the cranium in ancient mounds in Michigan."[41] Mr. Gilman was very positive that the perforations were not analogous to the prehistoric trephining observed in France. They were merely holes bored after death, and it was suggested by Professor Mason that, like the Dyaks of Borneo, the natives

[38] Bull. Soc. d'anthrop. de Paris, 1867, 2me sér., ii, 403.
[39] Amer. Naturalist, Salem, 1875, ix, 473.
[40] Proc. Am. Ass. Adv. Science, 24th meeting, at Detroit, 1875, Salem, 1876, 316–331.
[41] *Ibid.*, 26th meeting, at Nashville, 1877, Salem, 1878, 335–339.

The Inca skull brought by Mr. Squier from Peru.
(Photographed at Army Med. Museum.)

might have made the punctures for the convenience of stringing the skulls. This would explain why the hole was invariably at a point opposite to the foramen magnum. A discovery of Mr. Gilman's, however, seems to throw some doubt upon this theory. He found, in a mound at Devil River, Michigan, the remains of a person, evidently of rank, lying upon his back, but with the characteristic perforation in his skull.

Mr. W. C. Holbrook, in an account of his examination of some Indian mounds on Rock River, at Sterling, Ill., says:

> Inside this dolmen I found the remains of eight human skeletons. . . . One of the skulls presented a circular opening about the size of a silver dime. This perforation had been made during life, for the edges had commenced to cicatrize.[42]

It is not stated in what part of the skull the opening was found, nor whether any evidences of fracture or other injury existed, so that, as it stands, the case cannot be thought to be one of trephining, but rather one of a partly healed wound.

Before concluding this review of the evidence so far accumulated upon the subject, some account must be given of the method of trephining practiced in our own day by some semi-barbarous tribes, with the purpose of seeing whether it throws any light on the prehistoric operation.

In the djebel Aouràs (Mont Aurès), the southern termination of the Atlas mountain range, in the province of Constantine, in Algeria, there exists a race of Kabyles who are the descendants of the Berbers, the genuine autochthones of Africa. The practice of trephining prevails extensively among them, although it is by no means general among other tribes of Kabyles. Two French army surgeons, MM. L.-T. Martin[43] and Amédée Paris,[44] have given very full accounts of the method adopted.

It appears that the operation is performed for fracture of the skull, whether simple or compound, for disease of the bone, and for violent pains in the head. It may be performed at any age, upon either sex, and upon any part of the skull, though the parietal bones seem to be most frequently

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[42] Amer. Naturalist, Salem, 1877, xi, 688.

[43] La trépanation du crâne, telle qu'elle est pratiquée par les Kabyles de l'Aurès. Par L.-T. Martin. Le Montpellier méd., 1867, xviii, 525–535. *Also*, Reprint.

[44] De la trépanation céphalique pratiquée par les médecins indigènes de l'Aouress (province de Constantine). Par M. le dr. Amédée Paris. Gazette méd. de l'Algérie, Alger, 1868, xiii, 25–28. *Also*, Reprint.

chosen. M. Paris did not meet with any instances in which the operation had been performed upon subjects of less than ten or more than sixty years of age.

The instruments are rude and simple enough, consisting of a razor, a serpette, one or two saws, some straight and curved elevators, and the *brima*, or perforator. This latter is a metal rod, as thick as a ramrod, with a point an eighth of an inch long, but not over one-third of the diameter of the rod, which thus forms a shoulder and prevents too deep a penetration of the instrument. (See Plate VIII.) The point being fixed in the bone, after removal of the scalp by a crucial incision, the rod is taken between the hands of the operator, and by a rapid to-and-fro motion is made to revolve so that a puncture is produced. This is followed by another and another, until the fracture or the portion of bone intended to be removed is surrounded with a row of these holes, very close together. The saw is used to run them one into the other, and by means of the elevator the fragment is removed. The dentated edges are smoothed, a shield is fastened over the aperture, and appropriate dressings, with many ceremonies, applied. The operation is performed with great slowness, and is not generally completed at one sitting. It must, one would think, be exquisitely painful, but it is held to be a point of honor to exhibit no evidence of suffering, and if the patient should be so weak as to utter cries, he is jeered at, and even beaten.

The foregoing description of the method of operating is taken from the article by M. Martin. There is a difference in the procedure as related by M. Paris, who does not mention the use of the brima or of any analogous instrument. He says that the *thebibe* cuts out a square piece of bone, inclusive of the injured portion, with a saw, lifting the fragment with the elevator. Great violence is sometimes used in this part of the operation, and a portion of the outer or inner table is occasionally forced off, as in the accompanying figure; the bone from which it was drawn was in the possession of M. Paris.

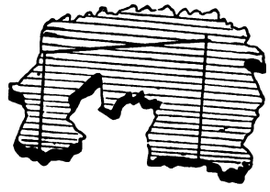


FIG. 2.—Fragment from Kabyle skull, forcibly broken out in the operation.

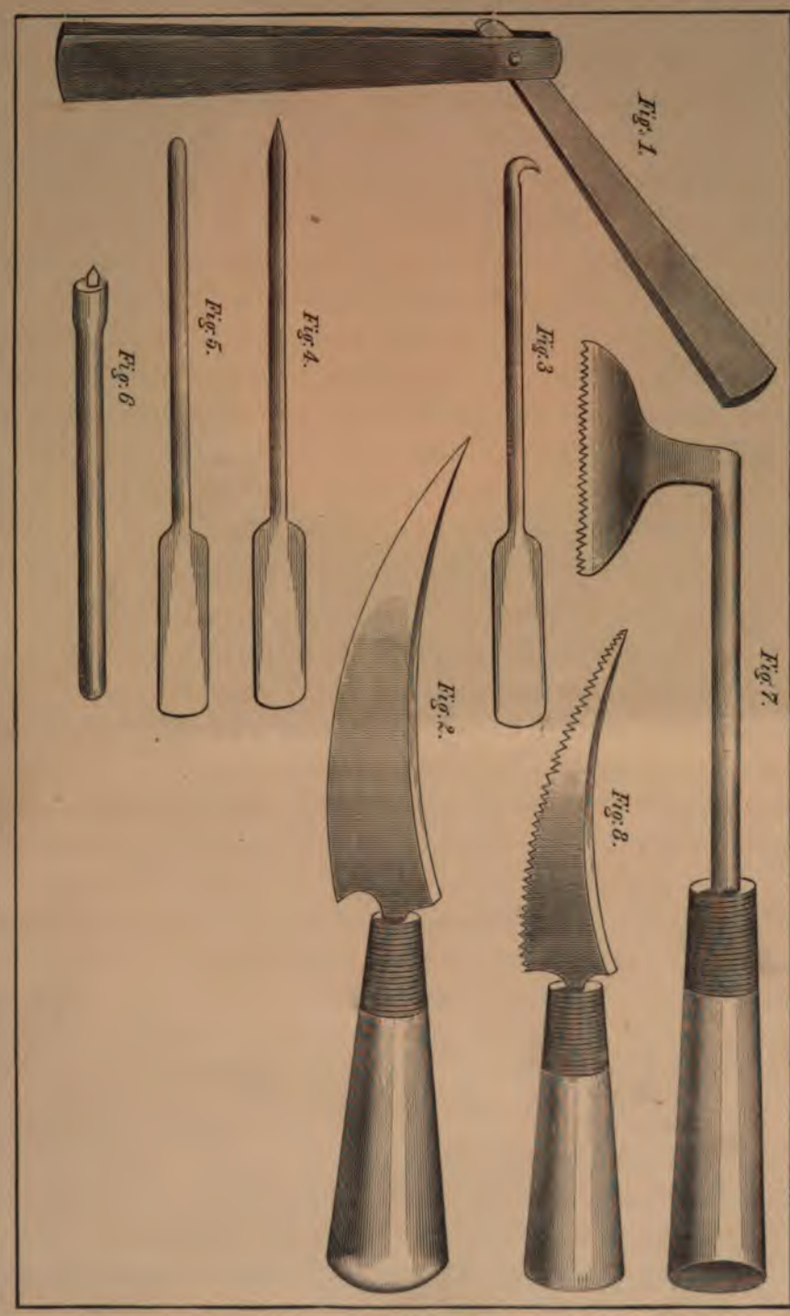


FIG. 1. Mouss (*razor*).
FIG. 2. Boussadi (*knife*).
FIG. 3. El-Chretaf (*hook*).
FIG. 4. Mesella (*elevator*).
FIG. 5. Chefra (*elevator*).
FIG. 6. Brima (*perforator*).
FIG. 7. Menchar (*saw*).
FIG. 8. Boussadi converted into saw.

Half-size. (Martin.)

The *thebibe* (operator) is a sort of semi-priest who has inherited the right to exercise his function; the operation, the instruments, the dressings, are all sacred, and the patient is held in reverence after recovery. The dressings consist mainly of woman's milk and of butter; the former obtained from a woman who has duly performed her religious rites. Both these ingredients figure in ceremonial observances in the Orient.

It is impossible to draw any conclusion as to the results of this process of trephining. The *thebibes* insist that it is always successful, but Arab mendacity is proverbial, and neither M. Paris nor M. Martin gives any credence to their statements. When commencing the incisions, the *thebibe's* formula is thus pronounced: *Thou wilt recover if it please God.* If the patient succumb, his family are told: *It was written.*

The natives, however, certainly regard the operation as without danger to life, and it is even resorted to as a means of extortion. M. Paris relates that two men having quarreled, one struck the other a blow on the body with a stick. Some days after the latter had his head trephined for a pretended fracture and sued his enemy for damages. The deception was exposed, and both patient and surgeon were punished. The *dieh*, or price of blood, is rigorously exacted among them, every injury, even a fatal one, having its established price. M. Martin mentions that he has seen men upon whom trephining had been practiced five or six times, so that their heads were monstrously disfigured. It is to be borne in mind that in these cases the operation was performed at intervals of time for different injuries.

A remarkable case has been recently published in which the patient was trephined five times within five years.[45] The disease of the bone for which these successive operations were performed originated in blows received in a brawl in 1875. The last trephining took place in 1880, and, so far, appears to have been successful.

In Otaheite, the operator's armamentarium consists of pieces of broken glass bottles for scraping, or, sometimes, of flints, shark's teeth for incisions, and pieces of gourd with shark tendons for strings with which to cover the opening produced. A missionary at Uvea, one of the South Sea Islands,

[45] A case of repeated trephining. By P. B. McCutchon. New Orleans Med. & Surg. Journal, 1881, ix, 259-261.

gives a very clear and interesting account of the method of trephining practiced at that spot.[46] He says:

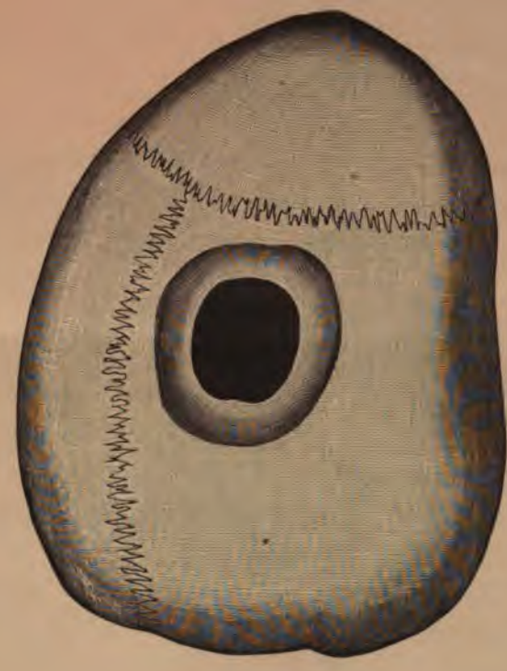
A very surprising operation is performed on the island of Uvea, in the Loyalty group. A notion prevails that headache, neuralgia, vertigo, and other cerebral affections proceed from a crack in the head or pressure of the skull on the brain. The remedy is to lay open the scalp with a cross or T incision, then scrape the cranium carefully and gently with a piece of glass until a hole is made into the skull, down to the dura mater, about the size of a crown piece. Sometimes this scraping operation will be even to the pia mater by an unskillful surgeon, or from the impatience of the friends, and death is the consequence. In the best of hands about half of those who undergo the operation die from it. Yet this barbarous custom, from superstition and fashion, has been so prevalent that very few of the male adults are without this hole in the cranium, or "have a shingle loose," to use an Australian phrase. I am informed that sometimes an attempt is made to cover the membranes of the cranium so exposed by placing a piece of cocoanut shell under the scalp. For this purpose they select a very hard and durable piece of shell, from which they scrape the softer parts and grind quite smooth, and put this as a plate between the scalp and skull. Formerly the trephine was simply a shark's tooth; now a piece of broken glass is found more suitable or less objectionable (if we may even so qualify the act). The part of the cranium generally selected is that where the coronal and sagittal sutures unite, or a little above it, upon the supposition that there the fracture exists.

The semi-religious character of all and everything concerned in the operation amongst the Kabylian tribes of Algeria is of special interest, as it seems to strengthen, by analogy, the theory that the subjects of prehistoric trephining acquired thereby a sacred character which led to the wearing of amulets from their skulls, as already described.

The curious suggestion has been made that the tonsure of priests is a perpetuation of the ancient custom of trephining. The Abbé Martigny, in his Dictionary of Christian Antiquities, says that the oldest Christian mosaics and manuscripts represent St. Peter with the tonsure as a mark of pre-eminence over the other apostles. It is probable that no weight should be attached to this fact. The picture galleries of Europe abound in Holy Families where tonsured monks of various orders are adoring the infant Christ—anachronisms which did not trouble the old masters. We know, too, that Brahmin priests, of a period long anterior to the Christian era, are represented as tonsured. This does not, of course, affect the question of the possible origin of the tonsure from the supposed sacred custom of trephining, but the matter may be safely left as unsettled.

The discoveries which have been made of late in mapping out the convolutions of the brain, or, as it is termed, the localization of function, have led to the reintroduction of trephining from a highly scientific stand-

[46] Native medicine and surgery in the South Sea Islands, by the Rev. Samuel Ella. Med. Times & Gaz., Lond., 1874, i, 50.



Cranium artificially trephined by M. Championnière.

point. Given, in injury of the head or abscess of the brain, the failure of a function, the locality of that function being known, there is the place to trephine. Some very remarkable results have been attained, and the consequence is that trephining has again become popular in France. Broca deserves the credit of being among the first to initiate this method of trephining.[47] This matter is referred to because a distinguished French surgeon, M. Lucas-Championnière, published a work upon the subject about four years ago, and in the introduction, speaking of prehistoric trephining, he takes the ground that the operation was not performed by scraping, as Broca supposed, but by a series of punctures such as have been described as produced by the Algerian operator.[48] To prove this, he took a flint weapon, and drilling a series of holes in a skull, afterwards ran them one into the other and removed the piece. The serrations were easily smoothed off with a piece of flint. The result could not be distinguished from the opening produced by scraping, the beveled edges being alike. (See Plate IX.)

This is ingenious and surprising; but while it must be admitted that the perforations *may* have been made by puncture, yet the existence of a considerable number of skulls *partially* trephined, the outer table only having been unmistakably *scraped* away, offers a strong presumption in favor of the latter method.

The following conclusions may be permitted:

1. The large number of perforated neolithic crania exhibiting cicatrized edges establishes the existence of a custom of trephining.

2. The operation was performed on both sexes, and generally at an early age.

3. The purpose is doubtful, but from analogy it would seem to have been for the relief of disease of brain, injury of skull, epilepsy or convulsions.

4. The operation was probably performed by scraping; possibly by a series of punctures. It is likely that the first was employed for children and the latter for the harder skulls of adults.

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[47] M. Legouest, the professor of military surgery at Val de Grâce, formulates this remarkable rule: "Singular as it may appear, I think the rule is that you should always trephine when you are doubtful whether it ought to be done"!

[48] Étude historique et clinique sur la trépanation du crâne; la trépanation guidée par les localisations cérébrales. Par Just Lucas-Championnière. Paris, 1878. 8°, p. 12.

5. Posthumous trephining consisted in removing fragments of the skull of a person who had undergone surgical trephining.

6. Each fragment was to exhibit a portion of the cicatrized edge of the original operation; and the purpose was, probably, to form an amulet to protect from the same disease or injury for relief of which the operation had been performed.

7. The evidence so far confines the custom to neolithic man on the continent of Europe.

ADDITIONAL NOTE.

Since the foregoing was printed a curious discovery has been made of something like "post-mortem trephining" in a remote region. Dr. Dybowski, who has been traveling in Yessel and the Aino lands, sent eight Aino skulls to Mr. Kopernicki, who observed in five of them that a resection of the foramen magnum had been performed in what he described as "a systematic manner analogous to the trephined skulls of the French dolmens." In one skull a portion only of the edge of the foramen magnum had been cut out; in another the alveolar process had been sawn off. He supposed that the purpose of the resection was not ceremonial, but medical, and that the excised bone was to be used as a remedy. Nothing is known of trephining among the Ainos.

Mr. Kopernicki sent the description of these skulls to the Ethnological Society of Berlin, and Professor Virchow remarked that there was no doubt that an artificial removal of fragments of bone had taken place, generally from the posterior and lateral sections of the border of the foramen magnum and the adjacent parts. In the three Aino skulls in his own collection nothing of the kind was to be seen, but a Goldi skull and a New Brandenburg skull presented similar lesions. He had supposed them, in the latter case, to be due to an attempt to make a drinking-cup of the skull, it having been found in the earth without any other parts of a skeleton, and in the frontal bone two small holes had been made as if for strings. The five Aino skulls in question had been dug out of graves by Dr. Dybowski himself, and he did not think the drinking-cup theory was applicable to them. He was unable to give any opinion as to the object of these resections.[49]

[49] Zeitschrift für Ethnologie, Berlin, 1881, xiii, 191–192. See, also, foot-note 3, p. 6 *ante*.

INDEX.

	Page.
Additional note	30
Aiguières, Dolmen near	6
Aino skulls	30
Algeria	15, 22, 25
——, Prehistoric trephining in	22
America, Prehistoric trephining in	23
American Assoc. Adv. Sci	24
Amulets	5, 6, 13
Athene, Birth of	15
Babert de Juillé	17
Baye, Grottoes of	16, 18
de Baye	16
Beaumes-Chaudes, Caverns of	18
Beinhaus at Sedleo	20, 21
Belief in future existence indicated by prehistoric trephining	15
Berbers	25
Bilin, Crania from	21
Bogdanoff, Tumulus at	22
Boixe, Forest of, Tumulus in	17
Bones found inside of crania	16
Bougon, Tumulus at	17
Boujoussac, Tomb at	13
Brain, Localization of function of, applied to trephining	29
Bray-sur-Seine (Marne)	18
Brima, instrument for perforating skull	26
Broca, Paul	5, 6, 7, 8, 9, 10, 12, 14, 15, 16, 22, 29
Brookville, Ancient cemetery at	6
Buckland, Miss A. W	15
Bytchiskala, Grotto of	19
Cartailhac, Ém	23
Casa da Mouva, Grotto of	23
Cavalry saber stroke on skull	9
Cavern of L'Homme-Mort	16
Chauvet	17
Chouquet	17
Cibournios, Dolmen of	11
Cicatrization of bone, Indications of	7
Cludset, Ingoald	21
Devil River, Mounds at	25
Dieh, or price of blood	27
Djebel Aouràs	25
Dogs, Charm for fits in	15
Drinking-cups of skulls	6, 30
Dudik, B	20, 21
Dyaks of Borneo	24
Dybowski, Dr	30
Denmark, Prehistoric trephining in	23
Écuelles, Mound at	17
Ellis, Rev. Samuel	28
Engelhardt	22
Entre Roche, Skull from	17
Epilepsy, Remedies for	14
——, Trephining for	14
Epileptic of the New Testament	14
von Erckert, General	21
Esthonian crania	16
Étang-la-Ville, Dolmen at	17
Faidherbe, General	22
Falster, Island of, Skull from	22
Foramen magnum, Resection of	30
Forehead never trephined	9
French Assoc. Adv. Sci	5, 13, 17
Furfooz, Crania from	16
Gassies	17
Germany, Prehistoric trephining in	19, 20, 21, 22
Gilman, Henry	24, 25
Goldi skull	30
Great Britain, No prehistoric trephining in	22
Guégan	17
Hephæstus	15
Holbrook, W. C	25
Horses killed by pole-axe, Skulls of	20
Hussites, Slaughter at Sedleo by	20
Inca skull from Peru	23
Internat. Cong. Prehist. Anthrop.	16
Italian Society of Anthrop	22
Italy, Prehistoric trephining in	22
Ivory-like surface of cicatrized bone	7, 11
Kabyles of Constantine	25
——, Trephining practiced by	25, 26, 27
Kopernicki	30
La Lozère, Dolmens of	5, 12, 13, 16, 18, 20
Lagneau, G. A	16
Langdon, F. W	8
Le Baron, Jules	9, 22
Legouest	29
Lisbon, Museum of	23
Livy	6
Lucas-Championnière, J	29
Lucian	15
McCutchon, P. B	27
Madisonville, Prehistoric cemetery at	8
Mantegazza	22
la Marconière, Dolmen at	13
Martigny, Abbé	28
Martin, L.-T	25, 26, 27
Mason, O. T	24
Mauvoisin	18
de Mortillet, A	16, 23
Musée Broca	9, 22
Nélaton	24
New Brandenburg skull	30
Nicolucci	22
Niort	17
Noes, Dolmen at	22
Norsemen drinking from skulls	6
Nott, J. P	24
Occipital bone, Trephining on	9
Os antiepilepticum	14
Ossa Wormiana	14
Otaheite, Trephining in	27

Page.
Parietal bones usual site for trephining 9, 25
Paris, Amédée 25, 26, 27
Parrot 9, 18, 19
Prunières 5, 6, 11, 12, 13, 16, 17, 18
Quatrefages 16
Quick, E. R 6
Race in relation to traumatism 11
Raclage or scraping 18
River Rouge, Mounds at 24
Rock River, Mounds at 25
Roknia, Skulls from 22
Rondelles 5, 6, 13, 16, 21
——, Counterfeit 23
Sable River, Mounds at 24
Schneider, L 22
Sedlec Beinhaus 20, 21
Skull, Congenital deficiencies of 9
——, Injuries of, from blows 8, 10
——, Reparative process of wounds of 10
——, Trephining of, for disease of bone 18
——, Wounds of 8, 9
Society of Anthropology of Paris 6, 9, 12, 17, 18, 23
—— of Ethnology of Berlin 20
South Sea Islands, Trephining in 12, 15, 27
Squier, E. G 23
Staggers in sheep cured by trephining 12
Strupcic, Skulls from 22

Page.
Taxil, Jehan 18
Tertre Guérin, Skulls from 17
Thebibes 26, 27
Tonsure a symbol of trephining 28
Trephining, Incomplete 18
——, Posthumous, on Aino skulls 30
——, Prehistoric, confined to neolithic age 16
——, ——, performed on females 9
——, ——, —— — young children 10
——, ——, Methods of 11, 12, 13
——, ——, Purpose of 14
——, ——, Posthumous 7
——, ——, Surgical 7
—— not dangerous *per se* 8
—— performed as a means of extortion 27
—— repeated on same person 18, 27
Uvea, Trephining in 27, 28
Vauréal (Oise), Cranium from 9
Veckenstedt 12
Velpeau 11
Virchow, Rudolph 21, 30
Wankel, H 19, 20, 21
Wiedersheim, R 22
Woman's milk as surgical dressing 27
Zeus, Trephining performed on 15
Ziemcin, Rondelle from 21
Ziska, John 20

Antiquity

II We no longer carry out cranial surgery with an ax, at least. The first account of a cranial operation is that set down by Lucian in describing the birth of the Greek goddess of wisdom. Zeus had a terrific headache. He suffered so intensely that he employed Hephaestus to strike him on the head with an ax. Hephaestus had some misgivings about this, but finally obliged. Zeus head was split open and, we are told, out jumped the goddess of wisdom fully clothed and with a spear in her hand.

But this is by no means the earliest evidence we have of cranial operation. It is mentioned because the idea that one might let some pernicious influence out of the skull by making a hole in it has lain through a good many early medical & religious beliefs. In 1874, after examination of a collection of neolithic skulls found in France, the great neurologist Broca was able to state that prehistoric man of the polished stone or neolithic period had practiced trepining of the skull for certain maladies. Since that time many specimens have come to light to indicate that trepination has been a widespread practice among

Araucanian Indians of South America are among the best known, but the practice was carried on by North American Indians, among Polynesians, and others. One tribe Algerian tribe trepanned the skull until very recently, and the operation has been witnessed by modern writers. It was carried out for fracture of the skull, following injury to the cranium - the purpose being to remove the injured portion of bone, and a good many of the patient appeared to survive. But whether they survived or not, the Oriental surgeon was inclined to be philosophical about the outcome. As the incision was made, he pronounced the formula - "Thou wilt recover if it please god". If the patient did not survive, the family was told "It was written". Some of you will realize that this way of looking at surgical operations has not entirely gone out of fashion today.

Though accounts of treatment of headache & convulsions occur frequently -- the idea being that the evil spirit producing the headache or the convulsion might escape through the hole made in the skull - the main concern of early surgeons in regard to the cranium had to do with injury to the brain and skull received in battle. D. Ap-Cann anatomist

F-1118-50M-P

Interrogation Between a Social Worker and Nurse the Lead Among the Question Are Used Based on the Work Experience Activity Experiences and Stress. (Use Table Showing Data Treatment for which Nurse Worked, and the Question Are Interrelated the Nursing Practice.) If you Having the Nurse Question by the Social Worker Are If the Question. The Question Based Among the Nurse Question a Long Lead a Good Warm a Lead Patient Behavior & Nursing Lead Nursing Also Answer a Nurse Question Are Nurse Question Are Nurse Question Are

once loaned me a translation of a Summerian manuscript on the treatment of wounds of the brain received in battle that showed considerable enlightenment. In fact, in some respects this early military surgeon was very modern indeed.

It can easily be understood that such wounds were frequent when warfare was carried on with clubs, the mace and pole-ax.

Today a relatively small percentage of brain injuries are produced in warfare. But we have modern agencies that are a thousand times more deadly than the mace and pole-ax – these are the engines of industry and, most important – the speeding automobile.

F 1118—50M—1

[redacted]

III Modern Considerations

1 - 115,000 - 18% = 20,000 die
2 - 38,000 deaths auto ax - 45% - 17,000 injury to brain (not skull)
3 - skill other traumatic surgery has outrun that of Rx of brain injuries.
4 - public health problem - if epidemic rampant killing 30,000 year wouldn't stand it minute - this not so vulnerable.
5 - what is it that makes figures of deaths brain inj so high?

IV Anatomical & Physiological considerations

1 - Brain box - cerebrum, cerebellum, medulla
2 - The cerebrospinal fluid
- elaboration
- ? circulation
- possible functions - cushion

V Pathological Correlations - general

1 - injection - meninges from outside
2 - pressure - (knock in, increase content)
3 - late effects of scarring - deformity

VI

F 1118-50M-2

[redacted]

VI Trauma - Injury

What happens elsewhere now pretty well known - ordinary fracture, the ruptured spleen, etc. What happens inside cranium not so well understood. Many theoretical explanations. When there are dozens of theories to explain some phenomenon easily observed, it is a medical axiom that little is known about the situation. The tenacity with which some of the older workers in this field cling to favorite theories characterizes, I think, difference between older & younger men. Younger workers are starting an attack on the problem on the basis that the field largely is unknown. It may be that, a few years hence, they will have something of value to tell us. For the present, there are certain broad principles that are proving useful, and certain new concepts that need emphasis. It is convenient to describe injury to the brain under several headings.

1 - Concussion - a clinical designation - that is to say, it has no pathological correlation. It applies to two states -

F 1110-50M

III Tesla – Tesla

(1)

What happens when two quite well known – existing theories, the magnetic & electric fields, suddenly, seemingly out of well established theory. Theoretical explanations allow this to occur in theory. A sufficient new phenomenon well observed is a working system that still is known about the attraction. So Tesla with which was a the odd working on this field which the current theory explained, I think. Magnetic behaviour which groups among themselves in strations on effect on the distribution or the main that the field lines in unknown. It may be that a few field lines will take something – taking it left and the current that for certain reason principle that on magnetic material and certain wire energy to that with conditions. It is convenient to describe using the main under general measurements.

1. Commutator – a mechanical disconnection – that is to say, it has no physical connections. It is like a tree that is in which indirect – and no

[redacted]

(1)

calling concussion "clinical designation" means that it has no pathological correlation. If specimens of brain taken immediately after instantaneous death - either by inspection or under mic - can it be told from normal. Or if a case of concussion + death ensues from some other cause - . . .

If, after blow, ~~so~~ symptoms appear such as headache, drowsiness, slowing of pulse or vomiting - brain injury has occurred. Responsibility here - aware of yours.

2. Infection
   - vulnerability
   - meningitis from fracture of bone above nose or into the cavity of the ear - resp
   - onsiblity here
   - the compound fracture

3. Compression - cut back to brain box

   - most baffling - most fatal cases manifest this and little else. The possibilities
     - increased blood vol
     - increase or decrease circulat of C.S.F.
   - theories + emerging evidence

F 1118—50M

- one remediable situation that can be recognized + cured surgically - need for closest observation - suggestive signs - child or adult who grows worse after injury - deepening drowsiness, lethargy, persistent headache, vomiting, etc. Operation.

VII Secondary importance of injury to cranium.
- bone - big it doesn't do something to brain, not worried. Changing views on X-Ray exam
- fracture of skull - important to newspapers
  - often associated c injury to brain
  - fast diagnosis
- important to lay public because stressed in papers
- disability + death proceed from injury to brain in every case

- occasionally significant
  - nose - cribriform plate - escape of CSF
  - ear
  - depressed
  - compound
  - crossing track of major vessel that may rupture → intracranial hem.

F 1118-50M-1

VIII Our responsibility

- treat conservatively in cases where the underlying situation not understood
- treat vigorously & promptly those situations that experience has taught us to recognize as demanding intervention
- continue study this baffling field

Yours

- stress fact that injury to brain, not skull, of paramount importance
- insist that when there is evidence injury to brain patient be under competent observation from first to last
- join in the every movements looking toward abatement of Texas's American ex rate

IX Require -

unconsciousness
csf nose or ear
drowsiness, headache,
stupor, vomiting, pal
blow on head